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ABSTRACT

Designed to provide useful information for middle school teachers and administrators involved in planning and implementing microcomputer programs in their schools, this focus paper begins with a brief discussion of the "who, what, when, where, and why" of microcomputers in the schools, followed by discussions of two types of relevant research: the effectiveness of computer-assisted instruction (CAI), and learning by middle school students. Descriptions of instructional applications discuss the microcomputer as the object of instruction, a tool of instruction, and a manager of instruction. Noninstructional applications for teachers are noted together with administrative and office applications, and guidelines for organization and management include a number of factors to be considered in the planning and implementation of the microcomputer program. The various groups that should be involved in inservice training are identified, as well as alternative approaches that can be used and the types of materials to be covered for the different groups. Comments about the impact and potential of microcomputer use at the middle school level conclude this paper. A reference list/bibliography lists 20 titles, and appended materials include (1) brief descriptions of six sample programs in Michigan schools; and (2) a resource list which includes 15 articles and books for educators, 10 organizations, projects, and resource centers; a periodical and 3 catalogs and directories; and 4 books for use by middle school students. (BBM)

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Focus On MICROCOMPUTERS IN THE MIDDLE SCHOOL

by

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FOREWORD

This Focus paper had been prepared in response to interest shown by the MAMSE membership in a survey conducted by the MAMSE Publications Committee during the 1983-84 year. The authors acknowledge with appreciation the assistance of Beverly Bancroft (graduate student at Michigan State University) in the planning, Janie Knieper (secretary at the University of Michigan) in the manuscript keyboarding, and Louis Romano (MAMSE Executive Director) in general oversight and prodding.

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Introduction

The arrival of a microcomputer in the classroom of the unprepared middle school teacher can bring with it only a surge of guilt and frustration. The guilt comes from the feeling that he or she is somehow unprepared for his or her profession. This is only amplified when the teacher realizes that many students in the class know more about the microcomputer than the teacher. The frustration comes from the feeling of helplessness generated when the teacher realizes the overwhelming array of possible uses and available software. The advent of the microcomputer has sparked a revolution which promises to affect middle school education in many ways in the next few years.

The scramble to include "computer literacy" as part of the middle school curriculum came far more quickly than many educators hoped for or were prepared to face. While the adoption of a new textbook may require substantial revision of lesson plans and more time in lesson preparation, the microcomputer demands new skills, increased flexibility, and in many cases, a whole new approach to teaching. Unlike a textbook which, if a teacher finds it threatening, can be quietly stowed away in a closet from one year to the next, this "new arrival" in the classroom is the object of much student interest, and they will insist that they have the opportunity to learn about and use it. Teachers can provide these opportunities in everything from arcade-like math practice to complex programming. Unlike a new textbook, the microcomputer does not come complete with a teacher's manual filled with ditto masters and easy-to-follow lesson plans. Some teachers have the necessary background and the willingness to deal with this new assault on their classrooms, while others cringe at these new demands.

Many of the issues involved in this "microcomputer revolution" can be classified into the five W's of newspaper reporting--who, what, when, where, and why; but each of these only leads to much more complex concerns that must be dealt with as microcomputers make their way into our schools.

Who? Who will be responsible for teaching and providing for "computer literacy" in both students and staff? Should each teacher be trained to work with microcomputers or should this be left to specialists in much to same way we teach music and art? Who should select the computer programs? Will schools provide the necessary training for teachers or can they demand that teachers prepare themselves? How do schools include and "cure" teachers, and more rarely students, who suffer from fear of computers (cyberphobia)?

What? What equipment (hardware) should be purchased? How many microcomputers are needed and what capabilities should they have? What additional equipment (peripherals) should be included to complement the microcomputers selected? What programs (software) should be purchased? How should software be evaluated? What should be taught? Is computer programming a necessary component? How should microcomputers be used?

When? In developing a microcomputer curriculum, when will the various aspects of "computer literacy" be taught? Should microcomputers be a separate area of the curriculum, be the responsibility of certain areas such as science or math, or be integrated into all subjects in the curriculum? Should the curriculum have the same expectations and requirements for all students or should students be tracked into different levels of expertise?

Where? Where should the microcomputers be housed? Is it more beneficial to have them used singly or in small numbers in regular classrooms, or combined into a single lab? How can the hardware and software be kept secure from damage and theft? Where will the funds come from to purchase the hardware and software?

Why? Why include microcomputers in the schools? Should computer literacy be considered a fundamental or just another fringe demand on an educator's overtaxed time? Even more basic, why learn mathematical computation when a microcomputer or even a handheld calculator is capable of doing the computation faster and more accurately?

Like mythological Hydra, who replaced its severed head with two more, the answering of any of these questions only leads to more queries. It is the premise of this focus paper that microcomputers are much more than a fad, and that their use can enrich the middle school curriculum and benefit the teachers and administrators who utilize them.

There is a wealth of information available which contributes answers to these questions. This focus paper considers some of these questions and available information which is relevant to the use of microcomputers in the middle school. The authors hope to provide useful information related to research data, instructional and non-instructional applications, organization and management, and inservice education. In offering these ideas the authors are very cognizant of the fact that some of this information will be outdated by the time it is published, for this is a very rapidly developing field.

If the reader's knowledge is increased somewhat, and interest is piqued to further pursue current developments, the authors' objectives will have been achieved.

Research Background

Do microcomputers increase or enhance student learning in the middle school? The main body of research on the effectiveness of computer-assisted instruction is relevant, although it does not speak directly to the question because the research took place prior to the era of microcomputers. Further, the most comprehensive reviews of the research did not separate out the findings for middle school students specifically.

This section will focus on two types of research relevant to this paper's topic: (a) effectiveness of computer-assisted instruction (CAI), and (b) learning by middle school students.

CAI. In a meta-analysis (review of previously conducted studies, applying rigorous quantitative research standards) of fifty-one studies of CAI in grades 6-12, Kulik et.al. (1983) came up with some clear results.

> The analysis showed that computer-based teaching raised students' scores on final examinations by approximately .32 standard deviations, or from the 50th to the 63rd percentile. Computer-based instruction also had smaller, positive effects on scores on follow-up examinations given to students several months after the completion of instruction. In addition, students who were taught on computers developed very positive attitudes toward the computer and positive attitudes toward the courses they were taking. Finally, the computer reduced substantially the amount of time that students needed for learning.(p.19)

The above findings were statistically significant. They found a tendency for more recent studies to produce stronger positive effects, suggesting improvement of CAI from pre-1970 to the 1975-79 period. About three-fourths of the studies analyzed took place in mathematics or science classrooms. About one-fourth of the studies were in grades 6-8.

In a later article Kulik and Bangert-Drowns (1983) also report limited evidence to suggest that CAI is effective only as a **supplement** to conventional teaching, not as a replacement for it. They also suggest that the effectiveness of CAI may be somewhat inversely proportional to the grade level of the student (decreasing effectiveness from elementary grades through college).

Most other reviews of research on this topic tend to be less comprehensive, less rigorous or less up-to-date. Two of them, however, might be singled out for mention. Johnston (1983), giving credit to Gleason (1981), offers these four generalizations:

1) CAI is most successful in helping learners attain clearly specified objectives, especially in the skill domain.
2) CAI saves significant amounts of time over "conventional" instruction, as much as 20 to 40 percent.
3) Retention rates following CAI are at least as good and often better than retention following conventional instruction.
4) Students have positive attitudes toward good CAI programs and they dislike poor programs, especially those over which they have no control. (p. 19)

Billings (1983), reviewing more recent research, includes positive results in the use of the computer for assisting students in problem solving, development of positive attitudes toward mathematics, and writing (both composing and revising). Most of these reported studies were at the middle school level.

Kulik and Bangert-Drowns (1983) Point out an important aspect of these reviews of research.

> Evaluations seldom reflect the newest applications of the computer in teaching. Meta-analyses lag especially for behind the leading edge in development. They provide at best a summary of the major themes in reported evaluation findings. With developments in computer technology occurring so swiftly, no one can predict with confidence what the next year, much less the next decade, will bring in computer-based teaching. (p. 155)

Middle school learner. Epstein (1978) has identified periods of brain growth spurts and plateaus (brain growth periodization) which may offer some explanation for observed learning patterns of middle school students. His work suggests a brain growth spurt usually occurring from ages 6-8 and again from ages 10-12, with plateaus (virtually no growth in brain mass and no significant increase in the complexity of the neural networks for 85-90% of the population measured) for ages 8-10 and 12-14. These brain growth spurts are often correlated with the Piagetian stages of development of concrete operations (ages 6-7) and formal operations (ages 10-11).

Epstein and Toepfer (1978) discovered positive correlation between brain growth spurts and mental age with a large number of intelligence-associated tests. I.Q. is more related to the "speed of learning," while cognitive level is related to the "style of learning." Shayer (1976, 1978) discovered that percentages of children working at the higher cognitive levels increase only at the ages of the brain growth periods. Shayer (1978) has shown that even in the gifted range of 14-year-old students about 30% do not show the capacity to perform formal operations. Toepfer (1980) states that "even at age 14 years, 76% of learners are still unable to handle material presented at the level of formal reasoning." Toepfer (1979) reports the effects of the "turn off" syndrome among school students as a side effect of inappropriately timed instruction.

A major implication of the brain growth periodization theory for the middle schools is that the vast majority of middle school students are pre-formal (concrete) thinkers (although most of the materials used in middle schools require formal thinking). Concrete thinkers are dependent on experiences which allow them to use previously developed thought patterns. They operate with the concrete, not the abstract.

Why has the recent flood of research and commentaries on early adolescent learning had so little effect upon middle school curriculum? Perhaps middle school educators are unable or unwilling to conceptualize and use this information. Current reasearch indicates that during the middle school years an attempt must be made to evaluate and determine the cognitive style and level of each student. However, traditional aptitude and achievement tests will not give much help in this area. Fortunately, Ross (1976) and Torrance (1978) have developed tests which help the teacher with this assessment.

Instructional Applications

The applications of the microcomputer in the instructional program of the middle school may generally be classified into three categories: (a) the microcomputer as an object of instruction, (b) the microcomputer as a tool of instruction, and (c) the microcomputer as a manager of instruction. Each of these roles deserves discussion.

Microcomputer as object instruction. Although "computer literacy" is a term which means many different things to different people, basic to almost any definition is inclucion of the notion of learning something about the capabilities and limitations of computers, and how to run programs.

Familiarization with the microcomputer keyboard and operation will enable the user to overcome any tendency toward cyberphobia, and to approach its assigned use with comfort and confidence. This function ordinarily occurs very early in the curriculum. If it has not been accomplished in the elementary school, then it should be undertaken early in the middle school curriculum.

Computer programming is a more advanced application. Different computer languages may be used but BASIC is by far the most commonly used language with microcomputers in the middle school. Some middle schools continue using the LOGO learned in elementary school, and a few advanced students may begin to learn PASCAL or some other language which is more powerful than BASIC. In many school districts no programming is formally taught prior to the high school level.

Microcomputer as tool of instruction. By far the major use of the microcomputers in today's middle schools is for computer-assisted instruction. In this capacity the teachers use microcomputers to teach skills or concepts more effectively (it is hoped) than could be done by other methods. Most of the software is commercially produced although some is prepared (or modified) by the middle school teacher (or occasionally an advanced student).

The majority of programs today, especially in math, are of the **drill and practice** variety. Here students are given the chance to exercise newly learned skills or to regurgitate facts that the teacher has somehow previously supplied to them. The unusually large number of programs of this type is not necessarily a measure of their value, but more a sign of their easy production. Teachers cannot expect students to learn new material with a drill program. Teaching is an important first step. Caution must be taken that the software gives practice in what the teacher has taught. As an example, a math program that requires answers to be put down from left to right is incompatible with a teacher's lesson demonstrating just the opposite.

Much of the drill and practice software available uses the arcade-like game approach that is highly suited to a middle school student's interest and competitive spirit. Further, such drill and practice activity is suggested by Epstein (1978) to be especially appropriate for this brain growth plateau period. In proper balance with effective teaching, these programs can involve and reinforce even the most reluctant student.

Tutorial programs provide for teaching new materials to advanced students or reteaching lessons to remedial students or to those who have been absent. In middle school classrooms, probably more than at other levels, individual differences in abilities are great. Without help, a teacher can easily be frustrated in trying to meet individual needs. Tutorial programs can offer more flexibility. Advanced topics in science or social studies, that the teacher may not be prepared to teach, can be offered as an option to some students. At the same time other students might be reviewing topics with which they had had difficulty. The tutorial offers an excellent way to enrich almost any classroom.

Role playing has always been found to be an effective teaching strategy to use with middle school students. Students learn more when they can personally relate to the material presented. **Simulation** software can bring this role playing even closer to reality by managing the information (data) while the students control the variables. Simulations are most appropriate for science and social studies topics and/or experiments. The programs are used when the real experiment can't be carried out because of expense, danger, excessive time requirements, or because it could affect society itself. Well known simulations allow students within one or two class periods to travel with explorers, run businesses, or perform dangerous or time-consuming experiments. Decisions that they make can change the course of history, as presented on the video screen. Software is available to involve single students, small groups, or even whole classes in the activity. Again, we see the flexibility that the microcomputer can provide in a middle school program.

Other software available are **educational games** and **problem-solving** programs. Educational games are used to motivate students, develop logical thinking and guessing skills, and often to present basic facts to students in new ways. Many times the student may be unaware that any learning is even taking place. Problem-solving software is similar to simulations if the student is able to manipulate a set of information to see how it affects other things. This is most applicable to topics in science, business or math. The tedium of long calculations is eliminated while the effects of even a small change are quickly apparent. This is especially valuable given the short interest span and limited math skills of many middle school students.

Microcomputer as manager of instruction. A use that teachers will find to be most valuable is the **materials generation** capacities that the microcomputer possesses. Individualized students reports

can be produced in minutes that outline everything from grades, where appropriate, to missing assignments. Some software allows teachers the opportunity to develop their own tutorial or drill and practice lessons without even learning about programming. Other programs enable teachers to produce multiple versions of tests and worksheets with the ease of pressing a few keys. Motivational materials like puzzles can be developed easily in minutes. These are but a few of the applications available. The reward from using this software is more time for teachers, both for themselves and for teaching and working with individual students.

Data base programs can give teachers and students near instant access to a variety of information. Cooperative class efforts can organize classroom data on everything from birthdays to book reviews. Students learn to organize information, evaluate its importance and store it for later use either by themselves or others. These programs provide an excellent way to involve students with the computer and make them aware of the tremendous abilities that it has in storing and organizing factual information.

Limitations and cautions. If the middle school educator takes seriously the Toepfer (1980) data regarding the middle schoolers' inability to handle material presented at the level of formal reasoning, it is imperative that this be considered when contemplating use of the microcomputer in the middle school instructional program. The teacher must be allowed to approach novel situations in familiar ways, to give the students opportunities to use what they are familiar with to solve the unknown. This type of instruction may take more time due to the built-in "messing around" time. Middle school teachers must plan activities which allow their students to manipulate objects and ideas concretely. These suggestions are explained in Piagetian theory and supported by Epstein's data.

Middle school teachers can do a great deal to involve their students in concrete thinking in spite of inappropriate textbook materials which require the students to think formally. Fuller (1980) has developed an instructional model called "Learning Cycle" which forces the teacher to consider the student's thinking level. The process includes the steps of **exploration, invention,** and **application**. The exploration step is the "messing around" time where students are introduced to a concept, presented in a concrete manner. Students try out different solutions and formulate questions. The invention step takes place when both the teacher and students are actively involved. The teacher helps the students in naming the concept and identifying its use. The application step

presents the concrete thinkers with extra practice in using the concept, and early formal thinkers can use the concept in a more abstract and sophisticated way.

Brazee (1981) speaks of models of instruction which "assist natural development" of brain growth through periodization stages. As middle school learners move from pre-formal to formal problem-solving modes, they must move from manipulating sets of objects to abstracting sets of symbols. When those symbols are numbers or words, an important CAI limitation might be computer-screen size. Suppose, for example, a teacher wishes learners to interpret information in a given paragraph of print. Basic interpretive approaches might include selection of appropriate details based upon similarities and differences, or applying specified classification criteria, or analyzing inherent sequences, or giving of specific reasons for conclusions drawn. Perhaps the learner is invited to select from a list of possible hypotheses and develop his/her proof from details in the paragraph. No matter which problem-solving approach is appropriate to the selected paragraph, such manipulations require constant shifting from the "question(s)" to the paragraph, and the conventional computer screen is probably not large enough currently to permit these shifts. Current approaches, such as worksheet-screen combinations partially solve the space limitation problem, but larger screen capacities, perhaps segmented to accommodate joint presentation of the analytical question(s) and the text to be analyzed would be a better solution, because that would simplify the mechanical shifting necessary to such problem solving.

Epstein and Toepfer (see Meadows-1983) suggest human services field experiences which bring middle school learners into close contact with community life. Such experiences provide many opportunities for application of concrete problem solving within structured environments. These experiences are also holistic and lead to affective well-being and growth. The middle school curriculum is already too far from the world of adult life. One of the responsibilities of the school is to plan for student interaction with the "real" world through first-hand, analytical contact. Holistic education of the emerging adolescent requires greater emphasis upon learning experiences based not only upon the student's interest(s), but also upon student's need to acquire and practice the skills of wholesome interaction. To accomplish these goals, the middle school program must be restructured to include a large component of structured experience outside the walls of the school.

Although this may seem to be an area with little application for microcomputers, computer software could be developed to provide rapid delivery of data bases, simulations, and problem-solving which would deal with significant social questions and build upon the community experiences of the middle schoolers.

In summary, the implications of computer technology in our midst are awesome. We must teach our students to think about the social implications of computer technology, just as we hope to keep before them the implications of their own behavior. While keeping social implications as a priority, the teacher can still effectively use the computer to assist instruction through drill-and-practice routines, learning games, and providing of information relevant to community interaction.

Software evaluation. In evaluating software the basic question has to be whether the same task can be done more easily or at least as well some other way. If so, unless the microcomputer adds some new dimension to the material, the software should not be used. Its use as an electronic workbook, or even a book where pages are turned with the return key, is completely inappropriate. Books and workbooks are cheaper and more convenient to use.

Teachers can get information about good software from a variety of sources. Many intermediate school districts are setting up preview centers for area teachers. Programs are reviewed in many magazines, although care must be exercised with these because of advertising implications. Specialized sources such as EPIE (see Appendix II) regularly evaluate educational software. Evaluation criteria and forms are available from many sources. Other teachers can provide much information about the effectiveness of what they have used. Most importantly, software must be tried before it is purchased.

Non-Instructional Applications

The microcomputer can assist the middle school teacher in a variety of non-instructional functions. Records of students' grades and attendance are among the most common. Averaging and reporting of students' grades and periodic reports or letters to parents are also made easier by the microcomputer. Updating of class lists is easy. Preparation of reports and papers for graduate level inservice classes is made easier. The imaginative middle school teacher will find many more non-instructional applications of the microcomputer.

Most of the non-instructional applications of the microcomputer in the middle school are found in the administrative or office area, however. Errors in the principal's letter can be corrected instantaneously. A frequently issued report, letter or handbook can be updated or revised slightly in just a few seconds. With Visi-Calc, revised budget projections of corrected attendance records can produce changed totals all across the spreadsheet with a single command. Add a telephone modem and a teacher or administrator can communicate with a subject specialist in the intermediate school district office or with a researcher at a nearby university. Although office practices will require some modification, the economics and increased efficiency which will result should be welcome in the era of budget difficulties and increased expectations.

Organization and Management

Effective organization and management is the key to the success of a microcomputer operation in any middle school. Of course, effective leadership is of prime importance, especially in the planning and organizing stages.

Organization of microcomputer instruction in a school must be based upon answers to questions such as the following: What do you want the microcomputers to do? How many microcomputers should be purchased? Will they set on tables or wheeled carts? If there will be printers and disk drives, will the tables or carts be large enough to hold these peripherals? How much space will be needed per microcomputer; for a total number of microcomputers? Which class or grade will be using the microcomputers? How often and during what times of the day will the microcomputers be used? How many students will use them? Will there be a computer education teacher on the site? Where will the microcomputers be located? (Will they be in a central location, in each classroom, in a few classrooms, or in one grade level only?) Will microcomputers be used in electives or in exploratory classes? What computer curriculum will be taught? Will the microcomputers be used for programming, remedial, drill, practice or advanced placement? What kinds of programs will be available? Where will funds come from to purchase the microcomputers? Which kind should be purchased? What is the budget to purchase programs and supplies of diskettes, cassettes, printer paper and ribbons?

One approach to organizing microcomputers is a network, which usually includes about 12 to 16 microcomputers connected to a teacher's monitor in the front of the room. Advantages in a

network organization include direct eye contact with each learner, being able to check the student's work from the teaching monitor, "sending out" materials to the students, and administering tests from the teaching station on a one-to-one basis. Textbooks and guides are frequently used to supplement the networking facilities.

Another organizational structure consists of a collection of interconnected microcomputers in a single location, frequently in an area of the media center or in an otherwise "empty" classroom. This area is frequently called the computer lab. Students and/or teachers may "sign up" for a particular period to use the facilities and frequently there is a trained teacher of computer education there (who may double as the media director or administrator). Sometimes the classroom teacher accompanies students to the lab, but more frequently that teacher needs to remain in the classroom with the rest of the students. Most labs cannot accommodate a class of 30 students. Usually a practice or "free time" is available for students to work on their program or to use a "game" tape. The interest of the students seems to be so high that some schools have found little need for supervision, other than custodial care to insure safety of the microcomputer and the software.

Still another approach to locating microcomputers in the school is to place one or more computers in individual classrooms. Structuring the use of the microcomputer, then, is designed in that classroom by students and teacher. Several teachers throughout a school may share these machines with each other. The hardware is moved from classroom to classroom on wheeled carts. Individual classroom teachers then assume responsibility for the childrens' computer education.

As the physical location of microcomputers in the middle school building varies, so does location of responsibility for the microcomputer program. Most frequently it falls to the media center director, which seems especially appropriate when the microcomputers are located in the media center. Alternatively an individual or curriculum area (such as mathematics, science or business) may be delegated responsibility for organizing and supervising the microcomputer program. This happens most frequently when that individual or curriculum area has taken the initiative to introduce microcomputers into that middle school's curriculum.

The support of the building and district administrators, the school board, and the community is crucial to the establishment and maintenance of a microcomputer program. In some districts,

parent organizations have been influential in helping their middle school purchase microcomputers for the students' education. These same parent groups have provided the "extra push" needed for a school administrator or school board to investigate computer education for the students in "their school." The parents want their children to be "computer literate," as they perceive the future to be technologically oriented. Some parent groups even purchased the microcomputers first and gave them to the schools, forcing the middle school educators to investigate and purchase software, and train the teachers to learn BASIC in order to teach their children. In some middle schools classroom teachers prescribe programs for individual students; parent volunteers then check out this software from the media center and supervise its use by the student in the computer lab.

Furniture availability and costs concern every microcomputer educator. The tables to accommodate microcomputers are only one of many costs in organizing the microcomputer program in middle school. Is the height of the table "correct" for the learner? Frequently nearby shop classes can build a microcomputer table for a relatively low cost that will have not only space for the microcomputer but also for the cassette drive, diskette drives and sometimes a printer; all this in addition to a space for the student to write. A device which attaches to the edge of the table, with a long arm which juts out to hold the work assignment at the correct level for the student's eyes, can be purchased for a few dollars, also.

Inservice Education

A middle school should not even consider introduction of microcomputers without commitment to a substantial inservice education program. Of course this inservice education should include both teachers and administrators. It should also have provisions for office/support staff and parents. Elementary and middle school students master this technology much more easily and quickly than do adults.

The inservicing of existing teaching staff, administration and office/support staff can be a massive task. Although a few enterprising persons in each group already may have undertaken formal computer classes on their own initiative, many educators are relatively ignorant of computer technology. Many are frightened of this "unknown." Some educators will eagerly pursue mastery of the technology when they realize its importance and usefulness, given released time and/or financial support from an enlightened Board of Education which likewise realizes the importance of computer education for the students of the school district. Other educators

will participate in this inservice education with reluctance, but will achieve minimum mastery, or possibly even get "turned on" to microcomputers. A few others may be so set psychologically against this new technology that they would prefer to take or await early retirement, rather than to become involved in learning something so radically new and different at this point in their careers. Computer preparation is required or elective today in almost all preparation programs for teachers, administrators, and secretaries. A school can well afford to hire only new staff who have some knowledge and predisposition toward the use of microcomputers.

Inservice education may be organized to include all the above groups in the same sessions, or separate classes may be organized for each group. Each approach has its advantages. Some schools prefer the democratic atmosphere of all working together to meet this new challenge. Most schools, however, find it more comfortable for the participants to approach this challenging and often frustration experience in job-related groups.

Whichever approach is used, participants should have maximum opportunity for hands-on experience during training sessions as well as ample opportunity for individual "experimenting" and practice between sessions. The trainer needs to be knowledgeable, but low key so that the threat of failure does not hang in the air. Inservices must be offered at different times throughout each year, because everyone isn't ready at the same time to learn the skills. To inservice once or twice and expect everyone to have learned the material isn't enough.

Although the school board may set goals and objectives for the microcomputer inservice education of the middle school staff, the participants should be involved in determining how these goals and objectives are to be achieved. As with any inservice education objectives, it is usually desirable that multiple routes be available to their achievement.

On-site inservice opportunities are convenient, but some educators prefer to join a group off-site where one doesn't know many of the people involved. One form of semester-long inservicing is for colleges to bring their instructors to a school district on a regular basis for basic instruction in computer literacy and/or programming. The computer models used are those which the district owns, and those which the teacher will be working on in the home building. Teachers may be encouraged to develop programs which they later can use in their classrooms. Held after school, often for college credit, this kind of opportunity may interest many staff members.

Late afternoon or evening classes may be available in nearby colleges to learn about the different kinds of computers, programs available, and language used by computers. Their labs usually are open to learners during the evenings and on weekends. Learners can follow through on assignments of programming or create their own programs to use in the classroom. Usually, tutors or assistants to the instructor are available to help with problems.

Still another approach for inservice education is when individual schools in a district hold training sessions for their own staff for one or more half or full days often inviting college personnel or an intermediate level media person to teach the sessions. Each teacher usually has a computer and can become acquainted with many programs which are available to the students for drill and practice reinforcement. Their own students are dismissed for that time period and perhaps for a follow-up session, held later in the year.

Word processing skills and Visi-Calc might well be the focus of workshops planned exclusively for secretaries and some administrators as well as support staff. Again, release time is probably desirable, but should be amply repaid by the increased efficiency in office procedures.

Time and money devoted to microcomputer education of parents might be well spent, also. Many middle school parents are able learners who would be quite interested in mastering the technology which has captivated their children. Some might use it only to be knowledgeable about what their child is doing on their home microcomputer. Others might use their training to assist as parent volunteers in a middle school classroom or microcomputer lab.

Attendance at conferences and reading of periodicals might be considered to be appropriate "advanced" inservice education. Both the Michigan Association of Middle School Educators and the National Middle School Association have a number of program sessions related to microcomputer usage in the middle school, many of their exhibitors are microcomputer oriented, and informal discussions in meeting rooms and hotel lobbies will yield valuable ideas from other middle school practitioners. Because microcomputer usage has become so important in middle schools, similar experiences may be enjoyed at almost any professional conference where attendees include middle school practitioners.

Similarly, worthwhile articles may be found in the current periodicals of these organizations, somewhat in proportion to that organization's emphasis on middle level education and/or technology.

Conclusion

There are numerous scenarios written to describe the education of the future. The common thread that runs through all of them is change. The change will come in what is taught, when it is taught and how it is taught. As society moves to a technology-infused future, the so called "basics" for the future. The three R's will still be around, but more emphasis will be placed on their use in thinking and problem-solving than on their mechanics, as is the focus today.

Middle schools will find themselves once again the sounding board for many of these changes, as their teachers will be asked to adjust to major innovations in both elementary and high schools. To equip for these changes, teachers must be prepared to attend classes, workshops and conferences, as well as read to keep abreast of the rapid transition. It is most important that they involve themselves with these changes to bring to the classroom the confidence and new skills demanded.

Adjustments will come in stages. While beginner level courses in computer literacy might be sufficient for today, the next few years might require teachers to know something about programming, robotics and topics that are not common knowledge today. It is the responsibility of middle school teachers to prepare themselves to do so. The microcomputer has brought a whole new dimension to the classroom. It's hoped that teachers realize its potential and work in cooperation with it to fully promote learning and thinking in middle school classrooms.

It would seem that many microcomputer uses were conceived with middle school students in mind. Effective use of available software will enable a teacher to individualize learning opportunities for all, from the remedial or handicapped student to those considered "gifted" and everyone between. Materials are available or can be produced easily by the teacher for all topics and needs. You might say the "teacher's aide" has returned to our middle schools in a different and more effective form--the microcomputer.

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APPENDIX I:
SAMPLE PROGRAMS IN MICHIGAN MIDDLE SCHOOLS

During the 1983-84 school year a number of Michigan middle schools volunteered information to the MAMSE Publications Committee regarding their microcomputer programs. Six of these have been selected for presentation here not because they necessarily are the best, but because they represent different approaches developed to meet specific objectives and capabilities of different districts. Districts are not identified, because personnel and programs are constantly changing.

A. Starting with Exploration in Grades 5 & 6

At Middle School A a mathematics teacher is devoting about half his time to two-week (10 class periods) courses required for all fifth and sixth grade students in the district. The fifth grade students are moved by bus to the middle school where the network of 16 Radio Shack microcomputers and the instruction are provided. The microcomputers are used a little in grades 7 & 8, primarily by the mathematics and special education teachers.

B. Required Grade 6, Elective Grade 7 & 8

This district recently converted to a 6-7-8 middle school organization. The computer curriculum is essentially the same in all three of the middle schools. Before entering middle school, the students have been involved with LOGO on microcomputers in the elementary school.

In sixth grade all students are introduced to BASIC in Exploring Computers, which meets on alternate days for one semester, with emphasis on applications. There are about 25 students in a lab which has 10 Apple Microcomputers and 3 terminals for the time-sharing minicomputer. A student may then elect Computer Studies A in the seventh grade which meets on alternate days for one semester. In the eighth grade a student may elect either Computer Studies A or Computer Studies B, which meets daily for one semester. Writing programs, problem solving, and more applications are included in these two electives. Ordinarily a student may elect no more than one of these computer courses per year. The terminals for the time-sharing minicomputers are used some with seventh and eighth graders, after an introduction in grade 6.

C. Required Grade 7, Two Electives in Grade 8

For several years Middle School C had required all seventh graders to take a ten-week (daily) course in computer literacy, including keyboarding skills. A second level computer course has been available in grade 8. This year in addition to this required ten-week course in seventh grade and this elective second level semester-long course in eight grade, a new elective BASIC programming course has been introduced in grade 8. Two math teachers, using a lab equipped with 16 Radio Shack are responsible for this program.

These computers also are used for programming in the weekly after-school electives program, and for data management by some of the more advanced eighth grade science students. In addition, students at all grade levels (6, 7 and 8) profit from the several microcomputers used in the reading improvement program.

D. Requirement for All Students, Grades 6 & 8

For several years Middle School D has required six weeks of computer orientation in grade 6, and offered eighteen weeks of computer literacy as an elective in grades 7 or 8. This year all sixth grade students are required to take six weeks of computer orientation and six weeks of keyboarding, and all eighth grade students are required to take eighteen weeks of computer literacy. Separate teachers are assigned to the sixth and eighth grade levels, but they share the same computer lab which is equipped with sixteen 16K TRS-80 microcomputers.

Despite location in an older building, Middle School D is committed to providing an up-to-date education for their 375 students in grades 6-8, and they believe that computer education is an essential component. Their population is mixed, but largely rural.

E. Required Programming for All Students, Grades 6, 7 and 8

At Middle School E all students (about 600) receive 45 periods per year of instruction in BASIC programming. This instruction is provided daily for nine weeks; it takes place on 14 Apples which are located in the same room with typewriters (which are not in use at the same time).

Of the three teachers involved in computer instruction, two are in the language arts/social studies area, and one is in mathematics. These middle school teachers, with suport from the principal, provided the impetus for the entire district's current interest in and support of a computer curriculum. They consider it important that the microcomputer use not be restricted to a single academic area.

F. Graphic Design and Animation in Art, Grade 8

At Middle School F eighth grade students may elect a one-semester art course in which almost all of the work is done on Apple microcomputers. The first part of the semester is devoted to graphic design; the latter part of the semester is given to animation. Each student prepares an animated film presentation for the class. At an open house the parents find these products to be very interesting.

Many of the students have little or no background with microcomputers before electing this class. The ratio of two students per microcomputer seems to work well.

APPENDIX II:
RESOURCES FOR MIDDLE SCHOOL MICROCOMPUTING

This is a selective list of resources available to the Michigan middle school educator interested in microcomputing. Much more extensive lists may be found in other sources, such as the Coburn entry below. Some of the annotations below have been adapted from Coburn's list, as well as from that of the Michigan Council of Teachers of Mathematics (entries 2 and 3 below). Michigan ISD offices and current periodicals should be checked frequently for additions and updates.

A. Books, Booklets and Articles for Educators

1. Baker, Justine. **Microcomputers in the Classroom**. PDK Fastback #179 Bloomington, IN: Phi Delta Kappa Educational Foundation, 1982. 48 pp.

   Brief introduction to computer literacy. Concise, readable.

2. Coburn, Peter et al. **Practical Guide to Computers in Education.** Reading, MA: Addison-Wesley, 1982. 266 pp.

   This excellent book suggests procedures for selecting computer hardware and software, and techniques for effective classroom use. Excellent annotated listing of available resources.

3. **Computers in the Mathematics Classroom**. Lansing, MI: Michigan Council of Teachers of Mathematics, Monograph #17. 1982. 141 pp.

   The purpose of this monograph is to describe and illustrate ways in which computer technology can be used in the teaching of mathematics.

4. Grady, M. Tim and Gawronski, Jane D., ed. **Computers in Curriculum and Instruction**. Washington, DC: Association for Supervision and Curriculum Development. 1983, 173 pp.

   This book is "for educators who are taking those first steps to purchase and use computers in schools." Curriculum applications, histories of successful programs, and strategies for staff development are included.

5. Malone, Thomas W. *"What Make Things Fun to Learn? A Study of Intrinsically Motivating Computer Games."* Palo Alto, CA: Xerox Palo Alto Research Center, 1980.

   The author discusses the results of three studies: one on computer game preferences and two on students using two particular instructional games (Breakout and Darts). He also presents a survey of the literature, a theory of intrinsically motivating instruction and a chapter on how to design instructional computer games. Especially helpful to teachers interested in using or designing computer instructional games.

6. Markle, Sandra. **Computer Tutor**. Learning Works, 1981. 48 pp.

Designed to help teachers of Grades 4-8 acquaint their students with computers, including activities which can be carried out either with or without access to computers.

7. Miller, Joan, et. al. **BASIC Programming for the Classroom Teacher**. New York: Teachers College Press, 1982. 262 pp.

Using everyday language and metaphors principally in the subjects of language arts and social studies, this book teaches the teacher to design customized lessons or to adapt commercial software to individual curriculum requirements.

8. Moursund, David. **Introduction to Computers in Education for Elementary and Middle School Teachers**. Eugene, OR: International Council for Computers in Education, 1981. 93 pp.

A book which is designed to help increase the teacher's level of computer education literacy, including an overview of hardware and software, and capabilities, limitations, applications and possible impact of computers in education.

9. Papert, Seymour. **Mindstorms: Children, Computers and Powerful Ideas**. New York: Basic Books, 1980.

This is a clearly written plea to educators to use computers in radically new ways to provide a radically different kind of education in "natural learning environments." The book describes and discusses with concrete examples Papert's work using Logo with young children at the Artificial Intelligence Laboratory at MIT.

10. Pitts, Marcella. **The Educator's Unauthorized Microcomputer Survival Manual**. Washington, D.C.: Council for Educational Development and Research, 1982. 58 pp.

This is a very practical resource for school personnel designed to discuss the pros and cons of computer technology and offer some strategies which educators might use to survive the influx of microcomputers into schools and possibly turn the much talked about "microcomputer revolution" to their advantage.

11. Taylor, Robert, ed. **The Computer in the School: Tutor, Tool, Tutee**. New York: Teachers College Press, 1980. 274 pp.

A collection of articles which provide a foundation for understanding the basic issues involved in using computers in schools, the teacher's role in helping the student to make full use of computing, and the general limitations of computer use.

12. Thomas, James L., ed. **Microcomputers in the Schools**. Phoenix, AZ: The Oryx Press, 1981.

A collection of over thirty articles by experts in the field dealing with selection considerations, hardware and software development, curriculum applications, and trends and issues. Annotated bibliography and appendices note further references for educators interested in classroom computer use.

13. **U.S. Congressional Hearings: Computers and the Learning Society**. Hearings, 1978. Order Number 052-070-04581-7. From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 02402. **Information Technology in Education: Potentials and Perspectives**. Hearings, 1980. Free from: Science and Technology Committee, 82-155 House Annex no. 2, Washington, D.C. 20515.

    Testimony by leaders in educational computing, describing many educational projects.

14. Weir, Sylvia, and Watt, Daniel. "LOGO: A Computer Environment for Learning-Disabled Students." **The Computing Teacher**, Vol. VIII, no. 5, 1981.

    The article describes a project in which Logo activities are integrated into the learning experiences of learning disabled students in grades 5 through 8. It discusses the benefits that these students gain by learning to program computers, the process of training teachers to integrate Logo into each student's individual learning plan.

15. Zalewski, Don, ed. **Microcomputers for Teachers — With Application to Mathematics and Science**. Bowling Green, OH: School Science and Mathematics Assoc., 1982. 116 pp.

    Most of this book provides a general introduction to computer literacy, selection of hardware and software, and materials development. The final chapter provides applications to science and mathematics.

B. Organizations, Projects and Resource Centers

16. Association for Computing Machinery (ACM), 1133 Avenue of the Americas, New York, NY 10036, (212) 265-6300.

    ACM has several special interest groups that focus on particular aspects of computing. The Special Interest Group on Computer Science Education (SIGCSE) and Special Interest Group on Computer Uses in Education (SIGCUE) produce periodic reports relative to educational applications of computers.

17. EPIE Institute, P.O. Box 620, Stony Brook, NY 11790, (516) 246-8664.

    The Educational Products Information Exchange (EPIE) Institute is a large educational advocacy group that provides detailed analyses of curriculum materials used in elementary and high schools. Along with the Microcomputer Resource Center at Teachers College, Columbia University, EPIE has instituted a Microcomputer Software File, which reviews commercially available software programs. EPIE also publishes **EPIEgram**, an "educational consumers' newsletter" of equipment and materials, which identifies inferior or unsafe equipment (including educational software and hardware) and provides indepth reviews of information sources on computers in education.

18. Educational Technology Center, University of California, Irvine, CA 92717, (714) 833-7452.

    Under the leadership of Dr. Alfred Bork, the Educational Technology Center maintains several projects designed to develop computer based materials for all levels of the curriculum. For example, the Development of Learning Skills in Early Adolescence project is developing computer-based modules specifically for junior high school children. Information on these projects is provided in their **Newsletter**.

19. Human Resources Research Organization (HumRRO), 300 North Washington Street, Alexandria, VA 22314, (703) 549-3611.

    HumRRO is a behavioral science research organization that is pursuing several projects on CAI systems and materials. **Computer Literacy: Issues and Directions for 1985** is based on a joint HumRRO and MEEC Conference (sponsored by NSF) held in December, 1980. "An Approach to Integrating Computer Literacy into the K-8 Curriculum" (October 1980) also available from HumRRO, is an initial report of the Computer Literacy Guides for Elementary and Junior High Schools Project. Professional papers outlining other research in computers in education are also available from HumRRO.

20. International Council for Computers in Education (ICCE), Dept. of Computer and Information Science, University of Oregon, Eugene, OR 97403.

    ICCE is an organization of more than 6,000 educators interested in instructional uses of computers at the precollege level. The organization publishes **The Computing Teacher**, and a series of booklets on instructional use of computers.

21. Project LOGO, Lincoln School, 194 Boylston St., Brookline, MA 02146, (617) 547-3890.
    Division for Study and Research in Education, 20C-109, 18 Vassar Street, Cambridge, MA 02139, (617) 253-7360.

    Under the leadership of Seymour Papert, the Logo Project developed a wide range of educational applications for Logo, a child-appropriate computer language. The Division for Study and Research in Education (SRE) acts, in part, as a Logo information center. SRE is also developing further the educational applications of Logo, including a project using Logo with the education of the handicapped, and a Logo music project. The objective of the Logo project at Lincoln School is to enable students in grades 4-8 to use Logo to control and "teach" the computer. Students solve problems and do programming in the interactive setting that this project provides.

22. Michigan Association for Computer Users in Learning (MACUL). c/o Larry Smith, 33500 Van Born Rd., Wayne, MI 48184.

    MACUL is an organization of educators interested in the educational applications of compuuters. A newsletter, a journal, and several conferences per year are sponsored by MACUL.

23. Minnesota Educational Computing Consortium (MECC). 2520 Broadway Drive, St. Paul, MN 55113, (612) 376-1101.

    MECC develops and distributes educational software. They publish a bimonthly instructional newsletter listing available materials. Non-Minnesota customers may obtain their products at very reasonable rates.

24. Microcomputer Software and Information for Teachers (MicroSIFT). 500 Lindsay Bldg., Portland, OR 97204, (503) 248-6800.

    MicroSIFT, located at the Northwest Regional Educational Laboratory, acts as a clearinghouse for K-12 software reviews. MicroSIFT distributes information about software availability and program evaluation. A quarterly newsletter, **MicroSIFT News**, is published.

25. Tri-County Computer Consortium (TCC). T. Schmeltzer, Oakland Schools, 2100 Pontiac Lake, Pontiac, MI 48054; T. Hartsig, Macomb ISD, 44001 Garfield, Mt. Clemens, MI 48043; L. Smith, Wayne ISD, 33500 Van Born, Wayne, MI 48184.

    Co-sponsored by Oakland, Wayne, and Macomb Intermediate School Districts, TCC collects, evaluates, and disseminates public domain educational software for the Apple, Atari, PET and TRS-80 microcomputers. The consortium has also produced a Computer Literacy Curriculum Guide (Project CLAS).

C. Periodical, Catalogues and Directories

26. **The Computing Teacher**. Department of Computer and Information Science, University of Oregon, Eugene, OR 97403, (503) 686-4414.

    Provided to individual and organizational members of the International Council for Computers in Education (ICCE). **The Computing Teacher** publishes general and technical articles on the instructional use of computers. It emphasizes precollege education and teacher training. Articles are provided mainly by teachers in the field. Included are programming corrections, suggestions, computing problems, and short software and book reviews. News items on conferences, projects, resource centers, and technological developments in computers are also regularly printed.

27. **Electronic Learning**. Scholastic Inc., 902 Sylvan Avenue, Box 2001, Englewood Cliffs, NJ 07632, (201) 567-7900.

This is a bi-monthly providing nontechnical introductions to varied educational uses of electronic technology in grades K-12. News columns including a Washington report and international items report innovations and official receptivity to computers, video, and other technology in education. The software reviews are useful. Commercial programs are evaluated by a group of educators who note the success of classroom applications as well as pedagogical and programming faults in the software. Regular features include: a primer for teachers with minimal computer literacy, teachers' suggestions for simple computer-based classroom activities, and guides to proposal writing and funding sources for the purchase of educational technology.

28. **Electronic Literature Review**. Technical Information Distribution Service, 40 West Ridgewood Avenue, Ridgewood, NJ 07450, (201) 444-8889.

This free catalogue lists and describes several hundred industry publications that cover both individual components and complete computer systems. Most such publications are also free.

29. **Microcomputer Directory: Applications in Educational Settings.** Monroe C. Gutman Library, Harvard University Graduate School of Education, Cambridge, MA 02138 (617) 495-4225.

This guide to schools with microcomputer programs and computing projects in traditional school settings and in alternative learning environments is a product of the staff of the Gutman Library. The first edition of the **Directory**, published in the spring of 1981, lists educational computing projects by state with descriptions included for each entry. The second edition, published in the spring of 1982 is expanded. Both are excellent guides to possible sources of information and ideas concerning applications developed by other educators.

D. Materials for Middle School Students

30. **Computer Literacy Activities for Elementary and Middle School Students**. Eugene, OR: International Council for Computers in Education, 1983. 56 pp.

A collection of twelve introductory activities for computer literacy concepts.

31. Luehrmann, Arthur; Peckham, Herbert; and Ramirez, Martha. **A First Course in Computing**. New York: McGraw-Hill, 1982.

This is an activity-oriented introduction to BASIC which includes both theory and practical applications in BASIC programming. Appropriate for middle school students.

32. Malone, Linda, and Johnson, Jerry. **BASIC Discoveries**. Palo Alto, CA: Creative Publications, 1981.

This book has many hands-on activities in BASIC coding and related subjects. Appropriate for middle school students.

33. Richman, Ellen. **Spotlight on Computer Literacy**. New York: Random House, 1982. 186 pp.

A well presented introduction to how computers work, their role in our lives, and BASIC programming. Appropriate for middle school students.

M.A.M.S.E. RESOURCES

THE MIDDLE SCHOOL - A HUMANIZING EFFORT **$14.50**

by Nicholas P. Georgiady, Addie Kinsinger, and Louis G. Romano

This filmstrip-cassette is an excellent presentation of the characteristics of a middle school. Can be used for teacher in-service or for parent groups interested in the middle school.

FOCUS ON A MIDDLE SCHOOL BELIEF SYSTEM **$2.50**

by Frank S. Blom, Glen K. Gerard and Addie Kinsinger

This publication is designed to inform teachers and parents of the philosophy of one of Michigan's middle schools.

FOCUS ON INTERSCHOLASTIC SPORTS AND AND THE MIDDLE SCHOOL **$2.50**

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This focus paper presents the case for and against interscholastic sports, and takes the position that there is no place for interscholastic sports at the middle school.

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by Nicholas P. Georgiady

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A checklist designed to help teachers, administrators and parents to determine if a school district has a middle school. It focuses on "The People," "The Instruction," "The Activities," and "The Structure."

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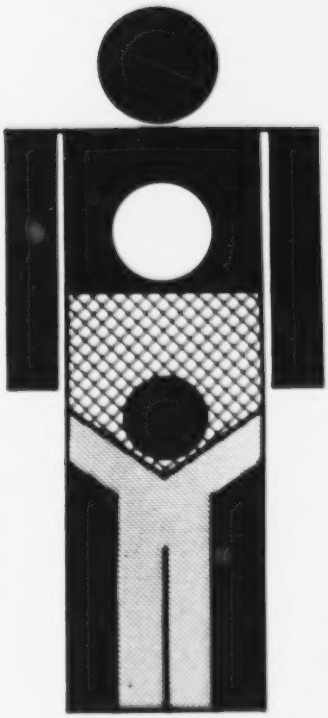

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